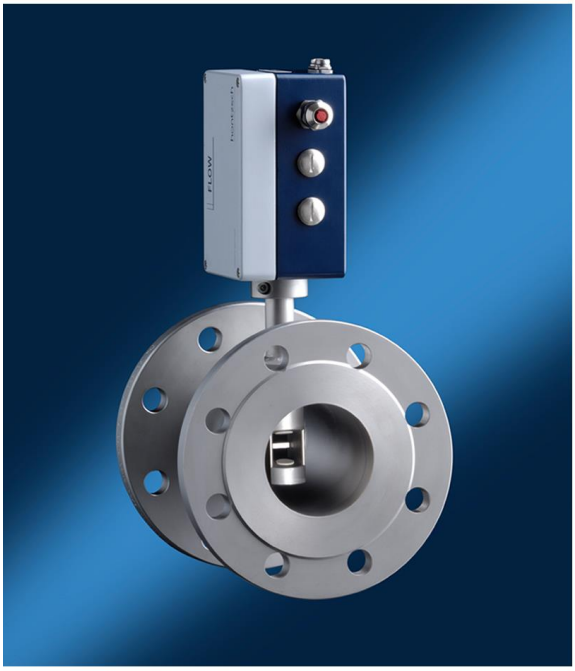
Safety Manual

- Probes VA40 ... ZG7 with integrated transducer UVA in AS80 housing
- Probes VA40 ... ZG10 with integrated transducer UVA in AS80 housing
- Measuring tubes VA Di ... ZG1 with integrated transducer UVA in AS80 or AS102 housing

- Probes VA40 ... ZG8 Ex-d with integrated transducer UVA-Ex-d in Ex-d flameproof housing
- Probes VA40 ... ZG9 Ex-d with integrated transducer UVA-Ex-d in Ex-d flameproof housing
- Measuring tubes VA Di ... ZG1 Ex-d with integrated transducer UVA-Ex-d in Ex-d flameproof housing

VA40 ... ZG7 + VA40 … ZG10 (PVDF)

VA40 ... ZG8 Ex-d + VA40 … ZG9 Ex-d



VA DI ... ZG1

VA DI ... ZG1 Ex-d

Contents

1 Safety Symbols

Warning! Failure to observe the instructions can result in serious injury and damage to property!

Important notice! Non-observance can result in serious damage to the equipment or performance restriction!

2 Operating Safety

All steps described below must be carried out by qualified personnel only!

Please read the Operating Instructions carefully before unpacking the equipment!

Safety can only be guaranteed if the equipment is operated in accordance with the regulations. Improper handling can result in serious injury and damage to property.

The Safety Manual is only effective in connection with the relevant Operating Instructions or Instruction Manual for Ex-instruments.

3 Planning / Layout

3.1 Ex-application

Approved appliances only are to be used for applications in potentially explosive atmospheres. Special attention should be paid to Instruction Manual UVA-Ex-d.

3.2 Choice of Installation Location

The place of installation must be chosen with care to optimise measurement accuracy. For tips refer to the Operating Instructions.

3.3 Safety Instrumented Systems according IEC 61508 SIL 1, SIL 2 and SIL2/SC3 (SIL 3 with 1oo2)

Requirements:
- Operation in Low Demand Mode
- The analog output values ≥21 mA and ≤3.6 mA are diagnosed as faults by the subsequent control unit; the process goes into safe mode.
- Safety functions cannot be implemented with the digital output, as no fault tracking can be effected via this output.
- A measurement error of less than 10 % of the measured value has no impact on the safety function.
- The efficiency of the equipment must be checked at regular intervals by repeated inspection.

4 Scope of Delivery

Please check that everything listed in the Technical Data Sheet is included in the delivery.
Also look out for potential small parts such as screw sets, seals, etc.

For use in 'Safe Applications (SIL 1, SIL 2 und SIL 3 in 1oo2)' the device must have a SIL logo on the **electronics housing and the SIL conformity must be confirmed in the Technical Data Sheet.**

5 Conformity with Standards

In addition, the following standards apply for the functional safety:

DIN EN 61508 Part 1 to Part 7:
Functional safety of electrical/electronic/programmable electronic safety-related systems

DIN EN 61511 Part 1 to Part 3:
Functional safety - Safety instrumented systems for the process industry sector

The flow measuring equipment complies with DIN EN 61508 Part 1 to Part 7 and may be used in safety instrumented systems according to DIN EN 61511 Part 1 to Part 3

6 Abbreviations and Definitions

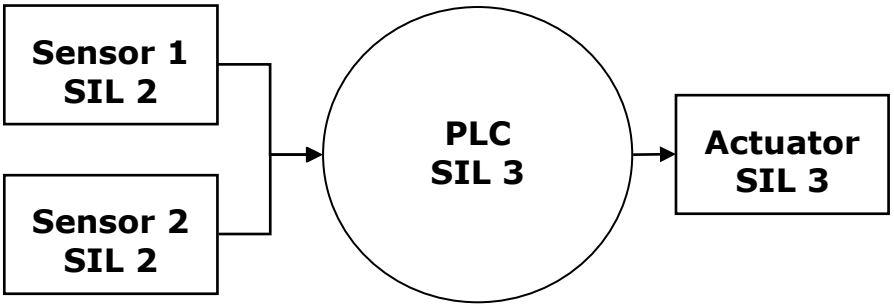
Abbreviation	Designation	Definition
	Functional Safety	Describes the part of the safety of a system that depends on the correct function of the safety-related (sub-) systems and external equipment for risk minimisation.
SIL	**S**afety **I**ntegrity **L**evel	To assess electrical / electronic / programmable electronic (E/E/PE) systems relating to the reliability of the safety functions. From the target level arises the safety-directed design principle, which must be observed to reduce the risk of failure. SIL 4 = highest level, SIL 1 = lowest level.
SIS	**S**afety **I**nstrumented **S**ystem	Safety instrumented system for carrying out one or more safety instrumented functions. A SIS consists of sensor(s), logic system and actuator(s).
	Mission Time	Mission time of the failure mode and effects analysis
PFDG/PFD_{avg}	**Av**era**g**e **P**robability of **F**ailure on **D**emand	Averaged probability of failure on demand of the safety function
PFS_{avg}	**Av**era**g**e **P**robability of **F**ail **S**afe	Averaged probability of causing a spurious trip of the process
OK		Probability product is running without any failures
FMEA	**F**ailure **M**ode and **E**ffects **A**nalysis	Failure mode and effects analysis
	Mode of operation	- operation in low demand mode, whereby the demand on the safety-related system is no more than once a year and not greater than the double frequency of the repeat test - operation in high demand or continuous mode, whereby the demand on the safety-related system is more than once a year or greater than the double frequency for the repeat test
SFF	**S**afe **F**ailure **F**raction	Fraction of safe failures relating to the total average failure rate
HFT	**H**ardware **F**ault **T**olerance	The capability of a functional unit to continue the execution of a demanded function in case of faults or deviations
FIT	**F**ailure **I**n **T**ime	1 FIT = 1 failure per 10^9 hours
λ	Failure rate	sd =safe detected su =safe undetected dd =dangerous detected du =danger undetected
MTTF	**M**ean **T**ime **T**o **F**ailure	s = safe d = dangerous
1oo2 SIL 3 (SC 3)	**1oo2 SIL 3 by redundancy setup, systematic capability (SC 3)**	Two identical devices are suitable for SIL 3 in architecture 1oo2. Each device can perform the safety function.
DC	**D**iagnostic **C**overage	s = safe d = dangerous

7 Safety Instrumented System (SIS)

A safety instrumented system generally consists of the three subsystems – input subsystem (sensor), Logic subsystem (PLC) and output subsystem (actuator).
The average probability of failure on demand PFDG/PFD_{avg} is usually distributed over the subsystems as follows:

Single-Channel SIS in 1oo1

Multi-Channel SIS in 1oo2



8 Average Probability of Failure on Demand (PFDavg)

This table indicates the attainable Safety Integrity Level (SIL) subject to average probability of failure on demand. The specified failure boundaries here are effective for a safety function in low demand mode.

Safety Integrity Level (SIL)	PFD_{avg} (low demand mode)
4	$\geq 10^{-5}$ bis $< 10^{-4}$
3	$\geq 10^{-4}$ bis $< 10^{-3}$
2	$\geq 10^{-3}$ bis $< 10^{-2}$
1	$\geq 10^{-2}$ bis $< 10^{-1}$

9 Safety Integrity of the Hardware

This table indicates the attainable Safety Integrity Level (SIL) for Type B devices (according to IEC61508-2) subject to Safe Failure Fraction (SFF) and the Hardware Fault Tolerance (HFT):

Safe Failure Fraction (SFF)	Hardware Fault Tolerance (HFT)		
	0	1 (0)*	2
< 60%	not allowed	SIL 1	SIL 2
60% to < 90%	SIL 1	SIL 2	SIL 3
90% to < 99%	SIL 2	SIL 3	SIL 4
≥ 99%	SIL 3	SIL 4	SIL 4

* With proof of operational reliability according to IEC / EN 61511 for SIL 1 to SIL 3

The certified equipment complies with SIL 2 with a systematic capability of SC3 according to IEC 61508 route 2. Deployment according to IEC 61511 for SIL 1 and SIL 2 in 1oo1 and for SIL3 in 1oo2 configurations.

10 Initial Operation

Initial operation is described in the respective Operating Instructions. For Ex-applications the respective Instruction Manual must also be observed.

11 Behaviour during Operation and in case of Failure

Behaviour during operation and in case of failure is described in the respective Operating Instructions.

12 Periodic Testing

12.1 Safety Checks

The safety function of the entire safety loop must be checked regularly in accordance with IEC 61508/61511. Check intervals are determined when calculating the individual safety loop.

12.2 Performance Check

The proper functional operability of the flow measuring device must be checked regularly at least every 5 years. This can only be carried out by the manufacturer.
In the case of unfavourable operating conditions shorter proof test intervals may be determined by the user.

13 Repairs

Defective devices should be returned to Höntzsch service and repairs department, preferably with a detailed breakdown of type of failure and possible reasons.

14 Safety-related Characteristics

Extract from Reliability Study No. 2266.465.1 Version 1 - Vortex Sensors

Properties:

Device Type: B
Mode of operation: low demand mode
Hardware fault tolerance: 0

Table 1 - Results FMEDA at +55 °C

Properties	VA40 ... ZG7 VA40 ... ZG10 VA40 ... ZG8 Ex-d VA40 ... ZG9 Ex-d VA Di ... ZG1 VA Di ... ZG1 Ex-d		
	FMEDA	Proven In Use	90% Confidence
Safe failure rate	248	40	62
Safe detected failure rate	0	n.a.	n.a.
Safe undetected failure rate	248	n.a.	n.a.
Dangerous failure rate	56	5.7	18
Dangerous detected failure rate	34	n.a.	n.a.
Dangerous undetected failure rate	22	n.a.	n.a.
DC	61%	n.a.	n.a.
Safe failure fraction	93%	n.a.	n.a.
MTTFd [years]	1768		

Notes:
Failure rates are in FIT 10^{-9}/h.
Confidence interval according to IEC 61508 route 2h.
IEC 61508 requires a minimum DC of 60% for Type B products for route 2h, 2s.

Table 2 - Results PFDG Calculations (1oo1)

	VA40 ... ZG7 VA40 ... ZG10 VA40 ... ZG8 Ex-d VA40 ... ZG9 Ex-d VA Di ... ZG1 VA Di ... ZG1 Ex-d				
Years	1	2	5	10	20
PFDG	9.8E-05	1.95E-04	4.9E-04	9.7E-04	2E-03
%SIL 2	1%	2%	5%	10%	20%
PFSavg			9.7E-05		

MRT, MTTR 8h

Table 3 - Results PFDG Calculations (1oo2)

	VA40 ... ZG7 VA40 ... ZG10 VA40 ... ZG8 Ex-d VA40 ... ZG9 Ex-d VA Di ... ZG1 VA Di ... ZG1 Ex-d				
Years	1	2	5	10	20
PFDG	5.7E-06	1.12E-05	2.77E-05	5.52E-05	1.10E-04
%SIL 2	1%	2%	5%	10%	20%

MRT, MTTR 72h, β 5% (common cause)

Summary results
The proven in use analysis demonstrates that the hardware of the Vortex Sensors VA40 ... ZG7/ZG10/ZG8/ZG9 and VA Di ... ZG1/Ex-d are corresponding with SIL 2 safety properties according to IEC 61508, route 2h and route 2s SIL 3 in 1oo2 configuration.

15

RISKNOWLOGY
SIL Certified Product

Certificate of compliance
Product

Holder	Höntzsch GmbH, Waiblingen, Germany
Compliant Item	Vortex Sensors VA40 ... ZG7 and VA40 ... ZG8 Vortex Sensors VA Di...ZG1 and VA Di...ZG1 Ex-d
Basis of Certification	IEC 61508:2010
Certification Include(s)	☑ Safety requirements specification ☑ Hardware requirements ☑ Reliability requirements ☑ Software requirements ☑ Basic safety ☑ User documentation

Functional Safety Data

Safety function:	See report
Mode:	Low demand
Type:	B
HFT:	0
Hardware compliance route:	2_H
Systematic compliance route:	2_S
Systematic capability:	SC3
Failure rates (FIT):	SD=0, SU=248, DD=34, DU=22
Safe failure fraction:	93%
Diagnostic coverage:	61%
Fit for use up to:	SIL 3
Fit for use up to:	STL 5

Certification Results	Risknowlogy certifies that the above Compliant Item meets the requirements of the Basis of Certification for the selected assessment(s). The Risknowlogy report 2266.465.1 are an integral part of this certificate.
Certificate Number	2266.465.2
Issue Date	2019-06-09
Expiry Date	After modification of Compliant Item

Certifier Dr. Michel Houtermans

RISKNOWLOGY www.risknowlogy.com

Höntzsch GmbH & Co. KG
Gottlieb-Daimler-Straße 37
D-71334 Waiblingen
Telefon +49 7151 / 17 16-0
E-Mail info@hoentzsch.com
Internet www.hoentzsch.com

Subject to alterations